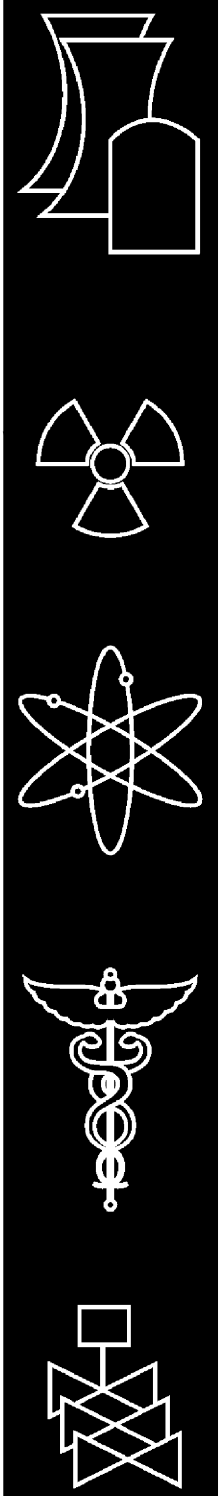
NUREG-1843



Safety Evaluation Report

Related to the License Renewal of the Browns Ferry Nuclear Plant, Units 1, 2, and 3

Docket Nos. 50-259, 50-260, and 50-296

Tennessee Valley Authority

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
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ABSTRACT

This safety evaluation report (SER) documents the technical review of the Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3, license renewal application (LRA) by the staff of the U.S. Nuclear Regulatory Commission (NRC) (the staff). By letter dated December 31, 2003, Tennessee Valley Authority (TVA or the applicant) submitted the LRA for BFN in accordance with Title 10, Part 54, of the *Code of Federal Regulations* (10 CFR Part 54). TVA is requesting renewal of the operating licenses for BFN Units 1, 2, and 3, (Facility Operating License Numbers DPR-33, DPR-52, and DPR-68, respectively) for a period of 20 years beyond the current expiration dates of midnight December 20, 2013, for Unit 1; midnight June 28, 2014, for Unit 2; and midnight July 2, 2016, for Unit 3.

The BFN units are located on the north shore of Wheeler Reservoir in Limestone County, Alabama, at Tennessee River Mile 294. The site is approximately 30 miles west of Huntsville, Alabama; it is also 10 miles northwest of Decatur, Alabama and 10 miles southwest of Athens, Alabama. The NRC issued the construction permits for Units 1 and 2 on May 10, 1967; for Unit 3 on July 31, 1968. The NRC issued the operating licenses for Unit 1 on December 20, 1973; for Unit 2 on June 28, 1974; and for Unit 3 on July 2, 1976. All of the units consist of a Mark I boiling water reactor (BWR) with a nuclear steam supply system supplied by General Electric Corporation. The balance of each of the plants was originally designed and constructed by the Tennessee Valley Authority. Unit 1 licensed power output is 3293 megawatt thermal (MWt), with a gross electrical output of approximately 1100 megawatt electric (MWe). Units 2 and 3 licensed power output is 3458 MWt, with a gross electrical output of approximately 1155 MWe. The units operated from the original licensing until 1985 when they were voluntarily shut down by the applicant to address management and technical issues. The applicant then implemented a comprehensive nuclear performance plan to correct the deficiencies that led to the shutdown. This plan included changes in management, programs, processes and procedures, as well as extensive equipment refurbishment, replacement, and modifications. Unit 2 was subsequently restarted in 1991, and Unit 3 followed in 1995. In the early 1990s, the applicant decided to defer restart of Unit 1. Unit 1 is currently in a shutdown status.

This SER presents the status of the staff's review of information submitted to the NRC through December 31, 2005, the cutoff date for consideration in the SER. The staff identified open items and confirmatory items that had to be resolved before the staff could make a final determination on the application. SER Sections 1.5 and 1.6 summarize these items and their resolutions. Section 6 provides the staff’s final conclusion on the review of the BFN LRA.

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Appendices

Tables

ABBREVIATIONS

AC	alternating current
ACI	American Concrete Institute
ACSR	aluminum conductor steel reinforced
ACRS	Advisory Committee on Reactor Safeguards
ADHR	auxiliary decay heat removal
ADS	atmospheric dilution system
AERM	aging effect requiring management
AFFF	aqueous film-forming foam
AFW	auxiliary feedwater
AHC	access hole cover
AISC	American Institute of Steel Construction
AMP	aging management program
AMR	aging management review
ANSI	American National Standards Institute
APCSB	Auxiliary and Power Conversion Systems Branch
APRM	average power range monitor
URI	unresolved issue
ART	adjusted reference temperature
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
AST	alternate source term
ASTM	American Society for Testing and Materials
ATWS	anticipated transient without scram
B&PV	boiler and pressure vessel
B&W	Babcock and Wilcox
BFN	Browns Ferry Nuclear Plant
BWR	boiling water reactor
BWROG	Boiling Water Reactor Owners Group
BWRVIP	Boiling Water Reactor Vessel and Internals Project
CAD	containment atmosphere dilution
CASS	cast austentitic stainless steel
CBF	cycle-based fatigue
CCCW	closed-cycle cooling water
CCWP	condensate circulating water pump
CF	chemistry factor
CFR	*Code of Federal Regulations*
CI	confirmatory item
CLB	current licensing basis
CMAA	Crane Manufacturers Association of America
CO_2	carbon dioxide
CRD	control rod drive
CS	core spray
CUF	cumulative usage factor

CVP	Cleanliness Verification Program
CWST	condensate water storage tank
DBA	design-basis accident
DBE	design-basis event
DC	design of civil structures
DCN	design change notice
DG	diesel generator or Draft Regulatory Guide
DGB	diesel generator building
dpa	displacements per atom
ECCS	emergency core cooling system
ECP	electrochemical potential
EDG	emergency diesel generator
EECW	emergency equipment cooling water
EFPY	effective full-power year
EMA	equivalent margin analysis
EMPAC	enterprise maintenance planning and control
EOL	end of life
EPRI	Electric Power Research Institute
EPU	extended power uprate
EQ	environmental qualification
ESF	engineered safety feature
EVT	enhanced visual test
FAC	flow-accelerated corrosion
F_{en}	environmental fatigue life correction factor
FERC	Federal Energy Regulatory Commission
FP	fire protection
FPC	fuel pool cooling and cleanup
FPR	Fire Protection Report
FSAR	final safety analysis report
FW	feedwater
GALL	Generic Aging Lessons Learned Report
GDC	general design criteria
GE	General Electric Corporation
GEIS	Generic Environmental Impact Statement
GENE	General Electric Nuclear Energy
GES	general engineering specification
GL	generic letter
GSI	generic safety issue
HELB	high-energy line break
HEPA	high efficiency particulate air
HH	handhole
HPCI	high pressure coolant injection
HPFP	high pressure fire protection
HSLA	high-strength low-alloy

HVAC	heating, ventilation, and air conditioning
HWC	hydrogen water chemistry
HX	heat exchanger
I&C	instrumentation and control
IASCC	irradiation assisted stress corrosion cracking
ID	inside diameter
IGSCC	intergranular stress corrosion cracking
IN	information notice
INPO	Institute of Nuclear Power Operations
IPA	integrated plant assessment
IPS	intake pumping station
IR	insulation resistance
IRM	intermediate range monitor
ISG	interim staff guidance
ISI	inservice inspection
ISP	Integrated Surveillance Program
kV	kiloVolt
LER	Licensee Event Report
LLRT	local leak rate test
LLRW	low level radioactive waste
LOCA	loss-of-coolant-accident
LP	layup program
LPCI	low pressure coolant injection
LPRM	local power range monitor
LR	license renewal
LRA	license renewal application
LTOP	low temperature over-pressure
LWR	light water reactor
MEAP	material, environment, aging effects, and aging management program
MEL	master equipment list
MeV	million electron Volts
MIC	microbiologically influenced corrosion
MS	main steam
MSIV	main steam isolation valve
MWe	megawatt electric
MWt	megawatt thermal
n/cm^2	neutrons per square centimeter
NDE	nondestructive examination
NEDP	Nuclear Engineering Design Procedure
NEI	Nuclear Energy Institute
NEIL	Nuclear Electric Insurance Limited
NEPA	National Environmental Policy Act of 1969
NFPA	National Fire Protection Association
NMCA	noble metal chemical application

NPS	nominal pipe size
NRC	U.S. Nuclear Regulatory Commission
NSR	non-safety-related
NSSS	nuclear steam supply system
NUREG	U.S. Nuclear Regulatory Commission Regulatory Guide
O_2	oxygen
OCCW	open-cycle cooling water
OE	operating experience
OFS	orificed fuel supports
OI	open item
PB	pressure boundary
PER	Problem Evaluation Report
PFM	probabilistic fracture mechanics
PT	penetrant testing
PTS	pressurized thermal shock
PUAR	Plant Unique Analysis Report
PVC	polyvinyl chloride
PW	pipe whip restraint
PWR	pressurized water reactor
PWSCC	primary water stress corrosion cracking
QA	quality assurance
RAI	request for additional information
RBCCW	reactor building closed cooling water
RBM	rod block monitor
RCIC	reactor core isolation cooling
RCPB	reactor coolant pressure boundary
RCS	reactor coolant system
RCW	raw cooling water
RG	regulatory guide
RH	relative humidity
RHR	residual heat removal
RHRSW	residual heat removal service water
RPV	reactor pressure vessel
RPVII	reactor pressure vessel internals inspection
RSW	raw service water
RT	reference temperature
RT_{NDT}	reference temperature nil ductility transition
RV	reactor vessel
RVI	reactor vessel internal
RWCU	reactor water cleanup
SBF	stress-based fatigue
SBO	station blackout
SC	structure and component
SCC	stress corrosion cracking

SCV	steel containment vessel
SER	Safety Evaluation Report
SGT	standby gas treatment
SI	surveillance instruction
SIL	Service Information Letter
SLC	standby liquid control
SMP	Structures Monitoring Program
SO_2	sulfur dioxide
SOC	statement of consideration
SOER	Significant Operating Experience Report
SP	shelter/protection
SPP	standard program and process
SR	safety-related
SRM	source range monitor
SRP	Standard Review Plan
SRP-LR	Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants
SRV	safety relief valve
SS	stainless steel or structural support or systems and structures
SSA	safe shutdown analysis
SSC	system, structure, and component
SSE	safe shutdown earthquake
TI	technical instruction
TIP	traversing in-core probe
TLAA	time-limited aging analysis
TS	technical specification
TVA	Tennessee Valley Authority
TVAN	Tennessee Valley Authority Nuclear
UFSAR	updated final safety analysis report
UNID	unique component identifier
USAS	USA standard
USE	upper-shelf energy
UT	ultrasonic testing
UV	ultra violet
V	volt
VFLD	vessel flange leak detection
VIP	vessel and internals project
WO	work order
XLPE	cross-linked polyethylene

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